NASA TECH BRIEF

Improved Computer Program for Elastic Analysis of Highly Redundant Structural Configurations

An improved computer program was prepared for the elastic analysis of highly redundant structural configurations. The direct stiffness method was used with an analytical model that can consist of almost any combination of straight, doubly symmetric members, curved members of circular arc, and rigid bodies. Punched output of flexibility and stiffness matrices can be obtained for use in a natural frequency analysis. Member reaction output in card or tape form can be used in conjunction with other programs to perform stress analyses. Program results have been found to compare favorably with experimental data when the assumptions of the analytical model are satisfied.

A 12×12 stiffness matrix, giving the three orthogonal forces, and the three orthogonal moments at the member ends as a function of the corresponding translations and rotations, is formed for each member. Member matrices are first computed in the local axis system, and then transformed to the global system. If some member and reactions are made zero, homogeneous equations result which enable the program to eliminate deflections corresponding to zero reactions. For each member attached to a rigid body, geometric relationships exist, assuming only small deflections, which permit the replacement of reactions and deflections at the end, or ends, of the member by the reactions and displacements at a point on the appropriate rigid body. In this manner, only 6 degrees of freedom are carried forth for each body.

If the load condition contains only forces and moments, the flexibility matrix is post-multiplied by the load vector, yielding a solution load vector of deflections. If the load condition contains some deflections, the load vector is modified by multiplying the known deflections by their coefficients in the large stiffness matrix, and subtracting the results from the load side of the equations. The reduced matrix is then inverted to yield the flexibility matrix for the structure under the deflection, or load and deflection conditions being investigated. The inverse matrix is then multiplied by the modified reduced load vector to yield the unknown deflections. Unknown loads corresponding to the known input deflections are then computed using the equations that were saved from the original stiffness matrix.

Notes:

1. This program was written in Fortran IV for an IBM 7094 computer.
2. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10330

Patent status:

No patent action is contemplated by NASA.

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of North American Aviation, Inc.
under contract to
Marshall Space Flight Center
(MFS-13087)

Category 06